

PATENT SPECIFICATION

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(54) IMPROVEMENTS IN OR RELATING TO ELECTROMEDICAL APPARATUS

(71) I, HANS NEMEC, an Austrian citizen, of A—6830 Rankweil, Austrasse 1, Austria, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to electromedical apparatus for the internal treatment of the body by means of interference currents.

In the last few decades the interference current process has acquired a position of major importance in electrical stimulation therapy. Austrian Patent Specification 165,659 disclosed the use of the electrophysiological phenomenon of the ambivalent stimulant effects of medium frequency alternating currents in the range approximately 1000 to 100,000 Hz, by virtue of which phenomenon such currents have no stimulating effect when their intensity remains constant but do have such an effect when it varies in a low frequency rhythm (between about 0 and 200 Hz). When two constant, medium frequency currents whose frequencies differ by an amount equivalent to a low frequency are applied separately and when the points of application are so selected that both currents flow through the area within the body which is to be treated, the areas of tissue near the electrodes (the parapolar areas) at the points of application remain unstimulated, whereas the stimulation exerted by the endogenous, low-frequency amplitude-modulated interference current is concentrated in the area within the body which requires treatment.

The nature and extent of organic reactions to electrical stimuli are largely determined by the intensity and frequency of the low-frequency modulations in the amplitude of the resultant medium frequency AC current (the interference current), which modulations act as stimulating pulses. While autonomic

processes are better excited by slow trains of pulses lying in the lower quarter of the low-frequency spectrum of stimulation (0 to 100 Hz), the higher part of the frequency range is preferably for bringing about tetanic muscular contractions, for which the optimum frequency is approximately 50 Hz. Pulse repetition rates of less than 25 Hz result in autogenous vibrations which, depending on the frequency may cause a rapid shaking accompanied by relaxation or a slow, deep-seated kneading movement.

However, advantage can only be taken of the opportunities described for selecting effects specific to certain frequencies or frequency ranges if the particular biological substrate involved retains its ability to react as a result of the stimulating current being varied. A stimulating current of constant intensity would become less and less effective as a result of accommodation or, because of fatigue, might even be dangerous. Conventional low-frequency current supply apparatus avoids this inconvenience by giving out stimulating currents which rise and fall in intensity in a slow rhythm at approximately 0.25 to 0.50 Hz.

With apparatus for interference current therapy based on the above mentioned patent Specification such surges in the endogenous low-frequency stimulating pulse can be produced neither at the frequency indicated as optimum nor in such a way as to provide an optimum range of frequencies, as a result of which the therapeutic effects are necessary limited because of accommodation and the strain exerted on the tissue. The cause of this shortcoming is the use of only two medium-frequency currents which are applied at a constant intensity. This circumstance is also the cause of another critical shortcoming of the manner of generating the endogenous stimuli.

Since currents in two intersecting direction only produce forces which are two-dimensional in their effect, the force

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which every single ion in the treatment region experiences, and which form the physical basis of the physiological mechanism of stimulation, are confined to only one plane. Given the three-dimensional nature of the stimulatable substrate and of the fact that the branched neutral network in three-dimensional, the resultant weakening of the electrical stimulus, which may be referred to as planimetric reduction, must perforce lead to a decrease in physiological and therapeutic effects.

To reduce the shortcomings and disadvantages mentioned, it has been recommended that the points of application be altered between individual sessions in a course of treatment, or else each of the electrodes for the two circuits, which are in the form of manual electrodes, are slowly moved by hand, as described in Austrian Patent Specification 191,082, or again the currents applied are made to vary in opposite directions, or finally attempts have been made to use quantity to compensate for the deficiency in quality by applying the infed currents in larger amounts, in which case the disadvantage has to be accepted that the stimuli at the electrodes caused by coupling, which become excessive as a result, have to be suppressed by additional means (as described in Austrian Patent Specification 203,147).

It is an object of the invention to avoid or minimise the said shortcomings and disadvantages.

The invention accordingly consists in electromedical apparatus for internal treatment of the body by means of interference currents, comprising independent primary, secondary and tertiary pairs of electrodes, an oscillator for generating a primary alternating current having a frequency of between 1000 Hz and 100,000 Hz connected between said primary electrodes, a second oscillator for generating a secondary alternating current having a frequency of between 1000 Hz and 100,000 Hz connected between said secondary electrodes, the operating frequencies of said primary and secondary generators differing by a value in the range between 0 and 200 Hz, and a third oscillator connected between said tertiary electrodes for generating a tertiary alternating current having a frequency differing by not more than 1 Hz from the primary or the secondary frequency.

It will thus be seen that the frequencies of the currents produced by two of said generators differ by an amount in the range 0 to 200 Hz, and the frequency of current produced by the third generator differs from one of said first two frequencies by less than 1 Hz.

By applying the electrodes in the appropriate way to be described hereinafter, the currents can be concentrated in a selected volume of tissue and can act in this area as endogenous stereometric stimuli which exhibit slow endogenous surges in intensity.

The apparatus exploits the possibility of stereometric application of stimuli, which is made feasible simply by the employment of three currents which flow in the three spatial dimensions and which have differing time functions, makes use of the phenomenon of dual interference, which is produced by interferential superimposition, on the interference current resulting from two interfering currents, of a suitable third current, and, when the proper relationship is selected between the frequencies of the three currents, makes possible endogenous surging at all frequencies or frequency ranges of the endogenous interference current which are indicated for therapeutic purposes. Also, as a result of the dual interference using a third current whose frequency is close to the carrier frequency of the first interference current, the opportunity is offered of producing extremely slow alterations in intensity since the difference between the frequencies generated in the apparatus may still be sufficiently large to avoid synchronisation. This technical advance makes it possible to use three virtually identical oscillator sets in place of complicated phase modulating arrangements. The three AC currents are generated by separate oscillators and are fed to the pairs of electrodes by separate output circuits.

One embodiment of the invention will now be referred to by way of example and with reference to the accompanying drawing, in which:

The Fig. shows a schematic view of the apparatus.

Referring now to the drawing, the electromedical apparatus 1 shown in the Fig. has three separate medium frequency generators 2, 3, 4 which, via separate outputs 5, 6, 7 and their respective pairs of electrodes 8—9, 10—11 and 12—13, which can be adjusted in all three dimensions so that the current paths between the pairs of electrodes lie in intersecting planes, each feed to the patient a medium-frequency current which on its own has no stimulant effect. One of the generators oscillates at approximately 4000 Hz at constant amplitude and constant frequency while the other two may be set, independently of one another and within a band from approximately 4000 to 4100 Hz, either to a fixed frequency or to a selectable frequency range which automatically varies. The

strengths of the currents are regulated and measured separately.

5 If, for example, in the case of a paresis, optimally tetanizing therapeutic stimuli of approximately 50 Hz are to be applied to the omni-directionally branched and deeply buried motor nerve-fibres of the muscles affected, for the purpose of electrically stimulated exercise, then, to trigger general
10 contractions which vary in a slow rhythm in all the muscles affected by means of a stereometric, electrical stimulating field of slowly varying intensity, the stimuli concerned must be generated directly in the treatment area 14.

15 For the treatment of, for example, painful, inflammatory, and rheumatic complaints, circulatory disorders and so on, it has proved satisfactory to make use of the endogenous action which exists in the autonomic frequency range of 8 to 25 oscillations per second, since this range causes self-generated vibrations and stimulates autonomic therapeutic processes
20 via the autonomic nervous system. To prevent accommodation to the spectrum of remedial stimuli, which would weaken their effect, the intensity of the stimuli must vary in a desired rhythm. For this purpose,
25 while one generator in the apparatus generates a current of 4000 Hz, the second generator is set for automatic frequency modulation of 4008 to 4025 Hz and for the third generator a value is sought which lies
30 somewhat above 4000 Hz and which is

associated with a distinct endogenous surge in the stereometric stimulating field at the desired "autonomic" rhythm of <1 per second.

WHAT I CLAIM IS:—

40 1. Electromedical apparatus for internal treatment of the body by means of interference currents, comprising independent primary, secondary and tertiary pairs of electrodes, an oscillator for
45 generating a primary alternating current having a frequency between 1000 Hz and 100,000 Hz connected between said primary electrodes, a second oscillator for generating a secondary alternating current
50 having frequency of between 1000 Hz and 100,000 Hz connected between said secondary electrodes, the operating frequencies of said primary and secondary
55 generators differing by a value in the range between 0 and 200 Hz, and a third oscillator connected between said tertiary electrodes for generating a tertiary alternating current
60 having a frequency differing by not more than 1 Hz from the primary of the secondary frequency.

2. Electromedical apparatus substantially as hereinbefore described with reference to the accompanying drawings.

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COMPLETE SPECIFICATION

1 SHEET

*This drawing is a reproduction of
the Original on a reduced scale*

